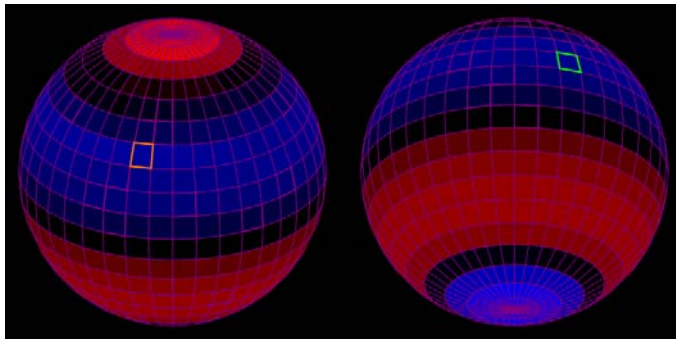


# Statistical Physics Of Nonlinear Dynamics

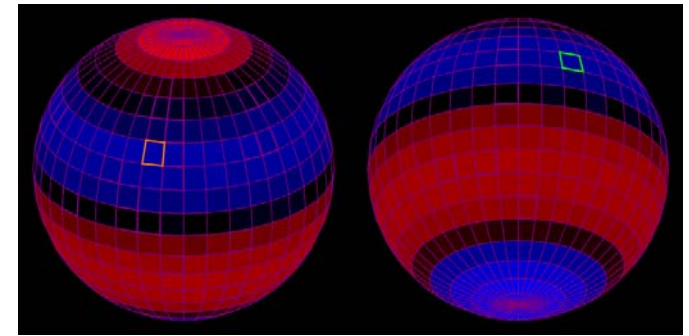
Brad Marston, Brown University, DMR-0213818

"More than any other theoretical procedure, numerical integration is also subject to the criticism that it yields little insight into the problem. The computed numbers are not only processed like data but they look like data, and a study of them may be no more enlightening than a study of real meteorological observations. An alternative procedure which does not suffer this disadvantage consists of deriving a new system of equations whose unknowns are the statistics themselves." [Edward Lorenz, *The Nature and Theory of the General Circulation* (1967)]

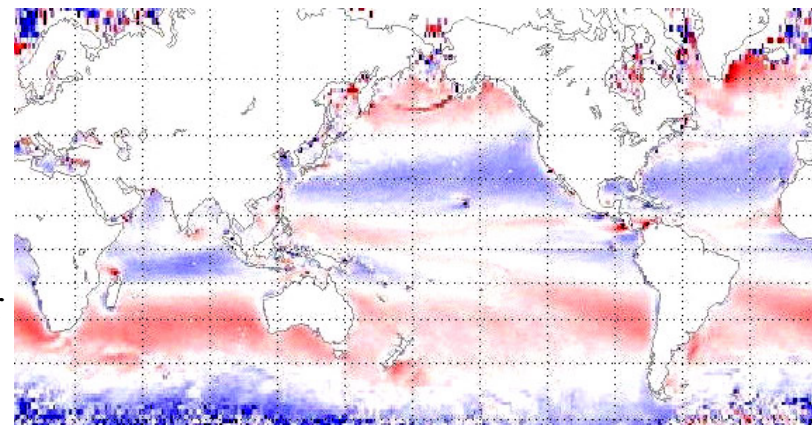


New Statistical Approach

We access the average behavior of the atmosphere -- the climate -- by mapping the equations of motion into a linear framework that resembles quantum many-body theory. Borrowing techniques from theoretical condensed matter physics, we have obtained preliminary results that agree qualitatively with direct numerical simulation and with observation (see figure at right).



Direct numerical simulation of vorticity in a quasi-geostrophic barotropic model of the Earth's atmosphere.



Observed Mean Vorticity  
(Based on QuikSCAT data. Figure courtesy E. Conover.)

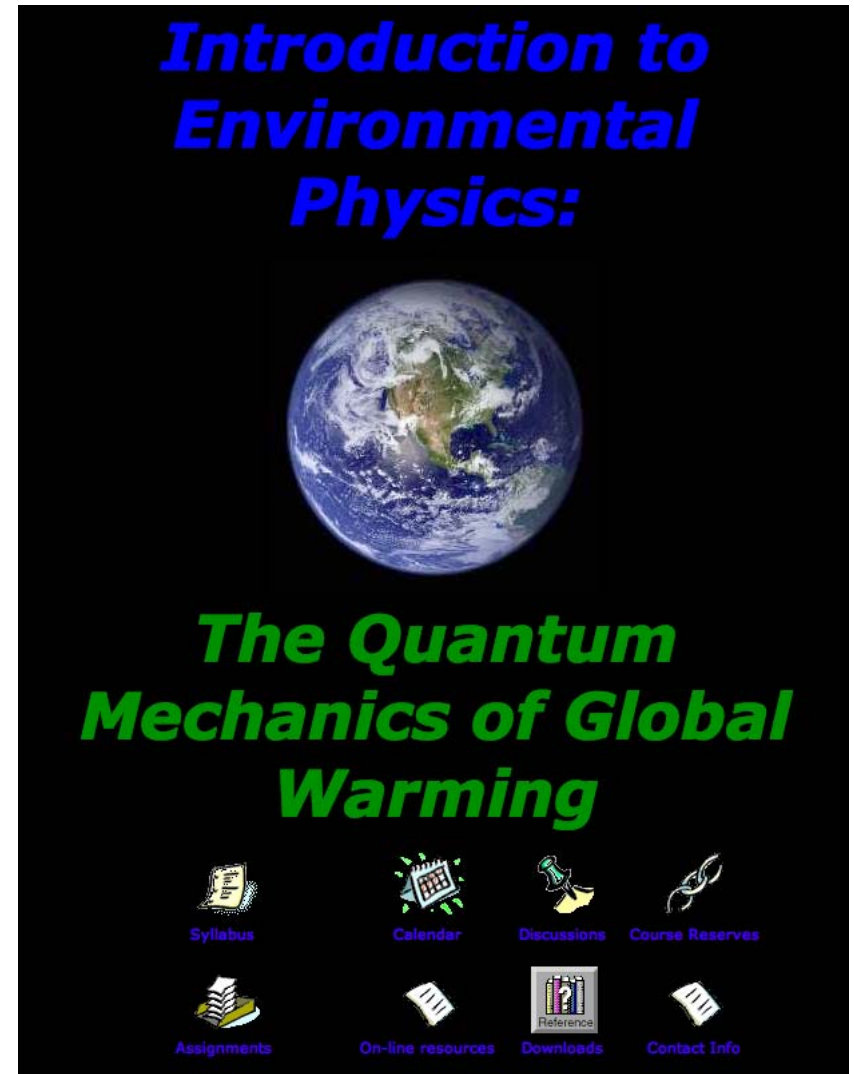
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**Broader Impacts:** I am co-organizing an interdisciplinary workshop on “Novel Approaches To Climate” to be held at the Aspen Center for Physics next year (summer 2005). One question we are asking is whether or not just throwing more powerful computers at the climate modeling problem is the best way to improve our understanding and predict future climate change.

**Education:** One Brown graduate student and two undergraduates are working with me on statistical approaches to climate.









In addition I am teaching a new freshman seminar that introduces first-year college students to quantitative thinking as applied to the environment (see web page at right).



**Introduction to  
Environmental  
Physics:**



**The Quantum  
Mechanics of Global  
Warming**

 Syllabus	 Calendar	 Discussions	 Course Reserves
 Assignments	 On-line resources	 Downloads	 Contact Info